E/ECE/324
E/ECE/TRANS/505 } Rev.1/Add.77/Amend.1
28 November 1990

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM CONDITIONS OF APPROVAL AND RECIPROCAL RECOGNITION OF APPROVAL FOR MOTOR VEHICLE EQUIPMENT AND PARTS

done at Geneva on 20 March 1958

Addendum 77: Regulation No. 78

Date of entry into force as an annex to the Agreement:
15 October 1988

Amendment 1

01 series of amendments which entered into force on 22 November 1990

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES OF CATEGORY L WITH REGARD TO BRAKING

UNITED NATIONS

Amend the title to read:

"... CATEGORY L VEHICLES 1/ ..."

Add a footnote

"1/ As defined in the Consolidated Resolution (R.E.3) (TRANS/SC1/WP29/78)".

Throughout the text change

"weight" to "mass"

Contents page, Annexes, add:

"Annex 4. Requirements applicable to vehicles of category L_1 and L_3 equipped with anti-lock devices"

Amend paragraph 1.1. to read:

"1.1. This regulation applies to the braking of power-driven vehicles having two or three wheels of the types defined in paragraph 2 below."

Add a new paragraph to read:

"1.2.3. Vehicles with a maximum mass of more than 1,000 kg"

Amend the following paragraphs to read:

"2.2.1. ... as defined in the Consolidated Resolution (R.E.3),"

"2.2.2. the maximum mass, as defined in paragraph 2.14,"

Insert a new paragraph 2.2.5. to read:

"2.2.5. a different type of braking device,"

Renumber paragraphs 2.2.5. to 2.2.9. as 2.2.6. to 2.2.10. respectively.

Paragraph 2.5.:

Delete "The transmission may be mechanical, hydraulic, pneumatic, electrical or mixed."

Amend paragraph 2.6. to read:

"2.6. 'Brake' means the parts of the braking device in which the forces opposing the movement of the vehicle are developed;"

Amend paragraph 2.8. to read:

'Component(s) of the braking device' means one or more ..."

Insert a new paragraph 2.9. to read:

"2.9. 'Combined braking system' means

2.9.1. in the case of vehicles of categories L_1 and L_3, a system whereby at least two brakes on different wheels are actuated in combination by the operation of a single control. This method of actuation requires a control which is independent of the second braking device which operates on one wheel only;

2.9.2. in the case of vehicles of categories L_2 and L_5, a braking device which operates on all the wheels;

2.9.3. in the case of vehicles of category L_4, a braking device which operates at least on the front and rear wheel. Therefore a braking device which operates simultaneously on the rear wheel and on the sidecar wheel is regarded as a rear brake."

Renumber paragraph 2.9. as 2.10.

Amend new paragraph 2.10.2. to read:

"... (monotonic function), and"

Insert a new paragraph 2.11. to read:

"2.11. 'Maximum design speed' means the speed which the vehicle cannot exceed, on the level and without undue external influence, taking into account any special limitations imposed on the design and construction of the vehicle;"

Renumber paragraph 2.10. as 2.12.

Insert a new paragraph 2.13. to read:

"2.13. 'Unladen vehicle' means the vehicle alone, as submitted for the tests, plus the rider alone and any necessary test equipment or instrumentation;"

Renumber paragraph 2.11. as 2.14.

Insert new paragraph 2.15.:

"2.15. 'Wet brake' means a brake or brakes which has/have been treated in accordance with paragraph 1.5 of annex 3 of this Regulation."

Amend paragraph 4.2. to read:

"An approval number shall be assigned to each type approved. Its first two digits (at present 01 corresponding to the series 01 of amendments which entered into force on 22 November 1990) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign ... ."

Amend title of paragraph 5.1.2.2. to read:

"5.1.2.2. Secondary braking (if fitted)"

Amend title of paragraph 5.1.2.3. to read:

"5.1.2.3. Parking brake (if fitted)"

Delete paragraph 5.2. and renumber paragraph 5.3. as 5.2.

Amend new paragraph 5.2.1. to read:

"5.2.1. Every vehicle of categories L_1 and L_3 shall be equipped with two service braking devices, with independent controls and transmissions, one acting at least on the front wheel and the other at least on the rear wheel.

5.2.1.1. The two service braking devices may have a common brake so long as a failure in one braking device does not affect the performance of the other. Certain parts such as the brake itself, the brake cylinders and their pistons (except the seals), the push rods and the cam assemblies of the brakes, shall not be regarded as liable to breakage if they are amply dimensioned, are readily accessible for maintenance and exhibit sufficient safety features.

5.2.1.2. A parking braking device is not compulsory."

Replace the renumbered paragraphs 5.2.3. to 5.2.5. (formerly 5.3.3. to 5.3.5.) with the following new paragraphs 5.2.3. to 5.2.8.:

"5.2.3. Every vehicle of categories L_2 and L_5 shall be equipped:

5.2.3.1. with either two independent service braking devices which together actuate the brakes on all the wheels, or

5.2.3.2. with a service braking device which operates on all the wheels and a secondary (emergency) braking device which may be the parking brake.

5.2.4. In addition, every vehicle of category L_5 shall be equipped with a parking brake device acting on the wheel or wheels of at least one axle. The parking brake device, which may be one of the two devices specified in paragraph 5.2.3.1. above, must be independent of the device acting on the other axle or axles.

5.2.5. The braking devices must act on brake surfaces permamently connected to the wheels either rigidly or through components unlikely to fail.

5.2.6. The component parts of all braking devices, where attached to the vehicle, shall be so secured that the braking devices do not fail in their function under normal operating conditions.

5.2.7. The braking devices shall operate freely when correctly lubricated and adjusted.

5.2.7.1. Wear of the brakes must be capable of being easily taken up by means of either manual or automatic adjustment. The brakes shall be capable of being adjusted to an efficient operating position until the brake linings have worn to the point of requiring replacement.

5.2.7.2. The control and the components of the transmission and of the brakes must possess a reserve of travel such that when the brakes become heated and the brake linings have reached maximum permitted degree of wear, effective braking is ensured without immediate adjustment being necessary.

5.2.7.3. When correctly adjusted the components of a braking device shall not, when operated, contact anything other than the intended parts.

5.2.8. In braking devices where the transmission is hydraulic, the receptacles containing the reserve fluid must be so designed and constructed that the level of the reserve fluid can be easily checked."

Amend paragraph 8. to read:

"8. CONFORMITY OF PRODUCTION

8.1. Vehicle (device) approved to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraph 5 above.

8.2 In order to verify that the requirements of paragraph 8.1 are met, suitable controls of the production shall be carried out.

8.3. The holder of the approval shall in particular:

8.3.1. ensure existence of procedures for the effective control of the quality of products,

8.3.2. have access to the control equipment necessary for checking the conformity to each approved type,

8.3.3. ensure that data of test results are recorded and that annexed documents shall remain available for a period to be determined in accordance with the administrative service,

8.3.4. analyse the results of each type of test, in order to verify and ensure the stability of the product characteristics making allowance for variation of an industrial production,

8.3.5. ensure that for each type of product at least the tests prescribed in annexes 3 and 4 to this Regulation are carried out,

8.3.6. ensure that any sampling of samles or test pieces giving evidence of non-conformity with the type of test considered shall give rise to another sampling and another test. All the necessary steps shall be taken to re-establish the conformity of the corresponding production.

8.4. The competent authority which has granted type approval may at any time verify the conformity control methods applicable to each production unit.

8.4.1. In every inspection, the test books and production survey records shall be presented to the visiting inspector.

8.4.2. The inspector may take samples at random which will be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own verification.

8.4.3. When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the tests carried out in application of paragraph 8.4.2. the inspector shall select samples to be sent to the technical service which has conducted the type-approval tests.

8.4.4. The competent authority may carry out any test prescribed in this Regulation.

8.4.5. The normal frequency of inspections authorized by the competent authority shall be once every two years. In the case where negative results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to re-establish the conformity of production as rapidly as possible."

Insert a new paragraph 9. to read:

"9. TRANSITIONAL PROVISIONS

9.1. As from the official date of entry into force of the 01 series of amendments to this Regulation, no Contracting Party applying this Regulation shall refuse an application for approval under this Regulation as amended by the 01 series of amendments. At the request of the manufacturer, Contracting Parties applying this Regulation may agree to the application of these amendments before the official date of their entry into force.

9.2. As from 24 months after the official date of entry into force mentioned in paragraph 9.1. above. Contracting Parties applying this Regulation shall grant approvals only if the type of vehicle corresponds to the requirements of the Regulation as amended by the 01 series of amendments.

9.3. Approvals granted before the end of the 24-month period following the official date of entry into force shall cease to be valid 48 months after the date of entry into force mentioned in paragraph 9.1., unless the Contracting Party which granted the approval notifies the other Contracting Parties applying this Regulation that the type-approved vehicle meets the requirements of this Regulation as amended by the 01 series of amendments.

9.4. Approvals granted to vehicles of category L in accordance with the 05 series of amendments to Regulation No. 13 continue to be considered equivalent to approvals granted in accordance with the original text of this Regulation."

Renumber former paragraphs 9 to 11 as paragraphs 10 to 12.

Amend Annex 1 to read:

"Annex 1

(maximum format: A4 (210 x 297 mm)

COMMUNICATION

issued by: Name of administration:

.....

.....

.....

concerning: 2/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINED

of a type of vehicle of category L with regard to braking pursuant to Regulation No. 78

Approval No. ... Extension No. ...

1. Trade name or mark of the vehicle: .....

2. Vehicle type designation by the manufacturer: .....

3. Name and address of the manufacturer: .....

4. Name and address of the manufacturer's representative (if applicable): .....

5. Summarized description: .....

5.1 Vehicle:

Category of vehicle: .....

Maximum mass of vehicle: .....

5.2 Engine: .....

5.3 Transmission:

Number and ratios of gears: .....

Final drive ratio: .....

Tyre dimensions: .....

5.4 Braking device: .....

Make(s) and type(s) of linings: .....

Service brake(s) (front, rear, combined) 2/

Secondary braking, parking brake (if applicable) 2/

Other devices (anti-lock brakes, etc.)

6. Technical service conducting approval tests: .....

7. Date of test report: .....

8. Number of test report: .....

9. Reason for extension of approval (if applicable): .....

10. Other remarks (if applicable), [right or left hand driven]: .....

11. Place: .....

12. Date: .....

13. Signature: .....

14. Annexed the list of parts constituting the approval documents, which can be obtained on request, submitted to the Administrative Service which has delivered the approval."

1/ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

2/ Strike out what does not apply.

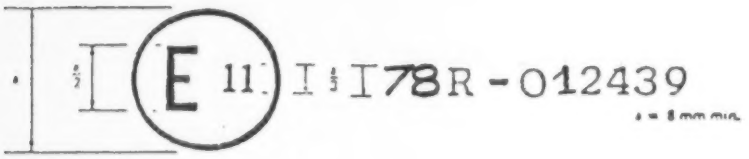
Amend Annex 2 to read:

"Annex 2

ARRANGEMENTS OF APPROVAL MARKS

Model A

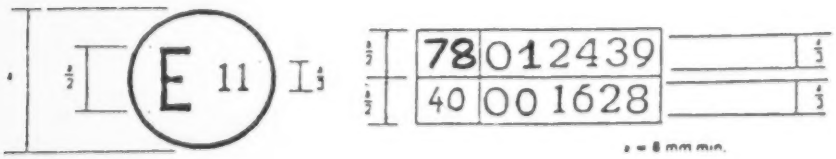
(See paragraph 4.4 of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to braking, been approved in the United Kingdom (E 11) pursuant to Regulation No. 78 under approval number 012439. The first two digits of the approval number indicate that Regulation No. 78 already included the 01 series of amendments when the approval was granted.

Model B

(See paragraph 4.5 of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the United Kingdom (E 11) pursuant to Regulations Nos. 78 and 40. */ The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No. 78 included the 01 series of amendments but Regulation No. 40 was still in its original form.

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*/ This latter number is given merely as an example."

Annex 3

Amend paragraph 1.1.1. to read:

"1.1.1. ... initial speed or measuring the response time of the device and the mean fully developed deceleration ..."

Amend paragraph 1.2. to read:

"1.2. ... conducted under the following conditions"

Amend paragraphs 1.2.1. to 1.2.4. to read:

"1.2.1. the vehicle's condition as regards its mass shall be as prescribed for each type of test and shall be specified in the test report;

1.2.2. the test shall be carried out at the speed and in the manner prescribed for each type of test: if the maximum speed of the vehicle does not conform to the speed prescribed, the test shall be carried out under the special, alternative conditions provided;

1.2.3. the prescribed performance must be obtained without locking of the wheel(s), without deviation of the vehicle from its course and without any abnormal vibration;

1.2.4. during the tests the force applied to the brake control in order to obtain the prescribed performance must not exceed the maximum laid down for the test vehicle's category."

Delete former paragraphs 1.2.5. to 1.2.8.

Replace former paragraphs 1.3. to 2.7. with the following new paragraphs 1.3., 1.4., 1.5., 1.6., and 2.

"1.3. Test Conditions

1.3.1. The service braking tests shall be carried out under the following conditions:

1.3.1.1. at the start of the test or any series of tests the tyres must be cold and at the pressure prescribed for the load actually borne by the wheels when the vehicle is stationary;

1.3.1.2. the vehicle shall be loaded, when required to be tested in the laden condition, with the weight distributed in accordance with the manufacturer's requirement;

1.3.1.3. for all type-0 tests the brakes must be cold: a brake is deemed to be cold when the temperature measured on the disc or on the outside of the drum is below 100° C;

1.3.1.4. the driver shall be seated in the saddle as for normal driving and shall maintain the same position throughout the test;

1.3.1.5. the test area must be level, dry and have a surface affording good adhesion;

1.3.1.6. the tests must be performed when there is no wind liable to affect the test result.

1.4. Type-0 test (service braking)

1.4.1. General

The limits prescribed for service braking performance shall be those laid down for each category of vehicle.

1.4.2. Type-0 test with engine DISCONNECTED

The test must be carried out at the speed prescribed for the category to which the vehicle belongs, the figures prescribed in this connection being subject to a certain margin of tolerance. In the case of vehicles where the two service brakes can be applied separately, the braking devices shall be tested separately. The minimum performance for each braking device for each category of vehicle must be attained;

1.4.2.1. in the case of a vehicle with a manual gear box or an automatic transmission where the gear box can be disengaged manually, the tests shall be carried out with the gear box inoperative and/or the engine disconnected by clutch disengagement or otherwise;

1.4.2.2. in the case of a vehicle with other types of automatic transmission, the tests shall be carried out under the normal operating conditions.

1.4.3. Type-0 test with engine CONNECTED for vehicles of categories L_3, L_4 and L_5

Tests must be carried out in the unladen condition at various speeds, the lowest being equal to 30% of the maximum speed of the vehicle and the highest being equal to 80% of that speed or 160 km/h whichever is the lower.

The maximum practical performance figures shall be measured and together with the behaviour of the vehicle must be recorded in the test report.

In the case where two service braking devices can be applied separately, both these braking devices shall be tested together and simultaneously, with the vehicle unladen.

1.4.4. Type-0 test with engine disconnected: with WET BRAKES

This test shall (subject to the exemption contained in paragraph 1.5.1. below) be carried out on vehicles of categories L_1, L_2, L_3 and L_4. The test procedure is identical to that for the type-0 test with engine disconnected, except for the provisions for wetting the brakes described in paragraph 1.5. of this annex.

1.5. Special provisions relating to testing with wet brakes

1.5.1. Enclosed brakes: it shall not be necessary to carry out this series of type-0 tests on vehicles equipped with conventional drum brakes or with fully enclosed disc brakes which are not subject to water penetration under normal running conditions.

1.5.2. The test with brakes subject to wetting shall be carried out under the same conditions as the test with dry brakes. There shall be no adjustment or alteration of the braking system other than fitting the equipment to allow brake wetting.

1.5.3. The test equipment shall continuously wet the brakes for each test run at a flow rate of 15 l/h for each brake. Two disc brakes on one wheel will be considered as two brakes.

1.5.4. For exposed or partly exposed disc brakes, the prescribed amount of water shall be directed on to the rotating disc in such a manner that it is equally distributed on the surface or surfaces of the disc swept by the friction pad or pads:

1.5.4.1. For fully exposed disc brakes, the water shall be directed on to the surface(s) of the disc 45° in advance of the friction pad(s);

1.5.4.2. For partly exposed disc brakes, the water shall be directed on to the surface(s) of the disc 45° in advance of the shield or baffle.

1.5.4.3. The water shall be directed on the surface(s) of the disc(s) in a continuous jet, in a direction perpendicular to the surface of the disc, from single jet nozzles so positioned as to be between the inner extremity and a point two thirds of the distance from the outer extremity of that part of the disc swept by the friction pad(s) (see figure in appendix).

1.5.5. For fully enclosed disc brakes, where the provisions of paragraph 1.5.1. above do not apply, the water shall be directed on to both sides of the shield or baffle at a point and in a manner corresponding with that described in subparagraphs 1.5.4.1. and 1.5.4.3. of this annex. Where the nozzle would be coincident with a ventilation or inspection port, the water shall be applied one quarter of a revolution in advance of the said port.

1.5.6. Where in the preceding paragraphs 1.5.3. and 1.5.4., it is not possible to apply the water in the position specified owing to the presence of some fixed part of the vehicle, the water shall be applied at the first point, exceeding 45° where uninterrupted application is possible.

1.5.7. For drum brakes, where the provisions of paragraph 1.5.1. above do not apply, the prescribed amount of water shall be distributed equally on either side of the braking device (that is, on the stationary back plate and the rotating drum) from nozzles so positioned as to be two-thirds of the distance from the outer circumference of the rotating drum to the wheel hub.

1.5.8. Subject to the requirements of the preceding subparagraph and to the requirement that no nozzle shall be within 15° of or coincident with a ventilation or inspection port on the stationary back plate, the test equipment for drum brakes shall be so positioned as to obtain the optimum uninterrupted application of water.

1.5.9. To ensure the correct wetting of the brake(s), the vehicle shall be driven, immediately before the commencement of the test series

With the wetting equipment functioning continuously as prescribed in this annex

At the prescribed test speed

Without the operation of the braking device(s) to be tested

For a distance of not less than 500 m prior to the point at which the test is to be carried out.

1.6. Type-I test (fade test)

1.6.1. Special provisions

1.6.1.1. The service brakes of all vehicles of categories L_3, L_4 and L_5 must be tested by a series of repeated stops, the vehicle being in the laden condition, in accordance with the requirements set out below (table under para. 2). For vehicles equipped with a combined braking system, it will be sufficient to submit this service braking device to the type-I test.

1.6.1.2. The type-I test shall be carried out in three parts:

1.6.1.2.1. A single type-0 test as required by paragraphs 2.1.2. or 2.2.2.1. of this annex.

1.6.1.2.2. A series of 10 repeated stops carried out in accordance with the requirements of paragraph 1.6.2. below.

1.6.1.2.3. A single type-0 test, carried out in the same conditions (and in particular at a control force as constant as possible of which the mean value is no greater than the mean force actually used in paragraph 1.6.1.2.1.) as those used for the test in subparagraph 1.6.1.2.1. above as soon as possible after the completion of the test specified in subparagraph 1.6.1.2.2. above but, in any case, within one minute thereof.

1.6.2. Test conditions

1.6.2.1. The vehicle and the brake(s) to be tested shall be substantially free from moisture and the brake(s) shall be cold;
a brake is deemed to be cold when the temperature measured on the disc or on the outside of the drum is below 100°C;

1.6.2.2. The initial test speed shall be:

1.6.2.2.1. for testing the front brake(s)

whichever is the lower of 70% of the vehicle's maximum speed and 100 km/h;

1.6.2.2.2. for testing the rear brake(s)

whichever is the lower of 70% of the vehicle's maximum speed and 80 km/h;

1.6.2.2.3. for testing a combined braking system

whichever is the lower of 70% of the vehicle's maximum speed and 100 km/h.

1.6.2.3. The distance between the initiation of one stop and the initiation of the next shall be 1,000 metres.

1.6.2.4. The use of the gear box and/or clutch shall be as follows:

1.6.2.4.1. In the case of a vehicle with a manual gear box or an automatic transmission where the gear box can be disengaged manually, the highest gear, consistent with attaining the initial test speed, shall be engaged during the stops.

When the vehicle speed has fallen to 50% of the initial test speed, the engine shall be disengaged.

1.6.2.4.2. In the case of a vehicle with a fully automatic transmission, the test shall be carried out under the normal operating conditions for such equipment.

For the approach, the gear suitable to the initial test speed shall be used.

1.6.2.5. After each stop, the vehicle shall immediately be subjected to maximum acceleration to reach the initial test speed and maintained at that speed until the initiation of the next stop. If appropriate, the vehicle may be turned round on the test track before acceleration.

1.6.2.6. The force applied to the control must be so adjusted as to maintain a mean deceleration of 3 m/s^2 or the maximum deceleration achievable with that brake, whichever is the lower, at the first stop: this force must remain constant throughout the succeeding stops required by subparagraph 1.6.1.2.2. above.

1.6.3. Residual performance

At the end of the type-I test the residual performance of the service braking device must be measured in the same conditions (and in particular at a control force as constant as possible the mean value of which is not greater than the mean force actually used) as for the type-0 test with the engine disconnected (the temperature conditions may be different).

This residual performance must not be:

if expressed as a deceleration, less than 60% of the deceleration figure achieved during the type-0 test, or if expressed as a stopping distance, more than the stopping distance figure, calculated in accordance with the following formula:

$$S_2 \leq 1.67\ S_1 - 0.67\ aV$$

where

S_1 = the stopping distance achieved in the Type-0 test
S_2 = the stopping distance as recorded in the residual performance test
a = 0.1
V = the initial speed at the beginning of braking as defined in paragraph 2.1.1. or 2.2.1. of this annex.

2. PERFORMANCE OF BRAKING DEVICES

2.1. Provisions relating to tests of vehicles with braking devices operating on the wheel or wheels of the front or rear axle only.

2.1.1. Test speed V = 40 km/h */ for categories L_1 and L_2,
V = 60 km/h */ for categories L_3, L_4 and L_5.

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*/ Vehicles of which the maximum speed (Vmax) is lower than 45 km/h in the case of categories L_1 and L_2 or 67 km/h in the case of categories L_3, L_4 and L_5, shall be tested at a speed equal to 0.9 Vmax.

2.1.2. Breaking performance with the vehicle laden

For the purposes of the type-I residual performance test (vehicles of categories L_3, L_4 and L_5), the recorded performance levels in terms of stopping distances, mean fully developed deceleration, as well as the control force used, shall be recorded.

2.1.2.1. Braking with the front brake only

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s^2)
L_1	$S \leq 0.1 \cdot V + V^2/90$	3.4
L_2	$S \leq 0.1 \cdot V + V^2/70$	2.7 */
L_3	$S \leq 0.1 \cdot V + V^2/115$	4.4 */
L_4	$S \leq 0.1 \cdot V + V^2/95$	3.6
L_5	$S \leq 0.1 \cdot V + V^2/75$	2.9 */

2.1.2.2 Braking with the rear brake only

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s^2)
L_1	$S \leq 0.1 \cdot V + V^2/70$	2.7
L_2	$S \leq 0.1 \cdot V + V^2/70$	2.7 */
L_3	$S \leq 0.1 \cdot V + V^2/75$	2.9 */
L_4	$S \leq 0.1 \cdot V + V^2/95$	3.6
L_5	$S \leq 0.1 \cdot V + V^2/75$	2.9 */

*/ If these values for single braking devices cannot be achieved because of limited adhesion, the following values shall be substituted for a test with the vehicle laden using both braking devices together: L_2, 4.4 m/s^2; L_3, 5.8 m/s^2; L_5, 5.0 m/s^2.

2.1.3. Braking performance with the vehicle unladen.

A practical test of the vehicle ridden by the driver alone shall not be required if a calculation shows that the distribution of the mass on the braked wheels allows a mean fully developed deceleration of at least 2.5 m/s^2 or a stopping distance $S \leq 0.1 \cdot V + V^2/65$ to be achieved with each of the single axle braking devices.

2.2. Provisions relating to tests of vehicles of which (at least) one of the braking devices is a combined braking system.

For the purposes of the type-I residual performance test (vehicles of categories L_3, L_4 and L_5, the recorded performance levels in terms of stopping distance, mean fully developed deceleration, as well as the control force used, shall be recorded.

2.2.1. Test speed V = 40 km/h */ for categories L_1 and L_2.
V = 60 km/h */ for categories L_3, L_4 and L_5.

2.2.2. The vehicle shall be tested unladen and laden.

2.2.2.1. Braking with the combined braking system only.

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s^2)
L_1, L_2	$S \leq 0.1 \cdot V + V^2/115$	4.4
L_3	$S \leq 0.1 \cdot V + V^2/132$	5.1
L_4	$S \leq 0.1 \cdot V + V^2/140$	5.4
L_5	$S \leq 0.1 \cdot V + V^2/130$	5.0

2.2.2.2. Braking with the second service or the secondary (emergency) braking device, all categories:

the stopping distance must be:

$S \leq 0.1 \cdot V + V^2/65$ (corresponding mean fully developed deceleration: 2.5 m/s^2).

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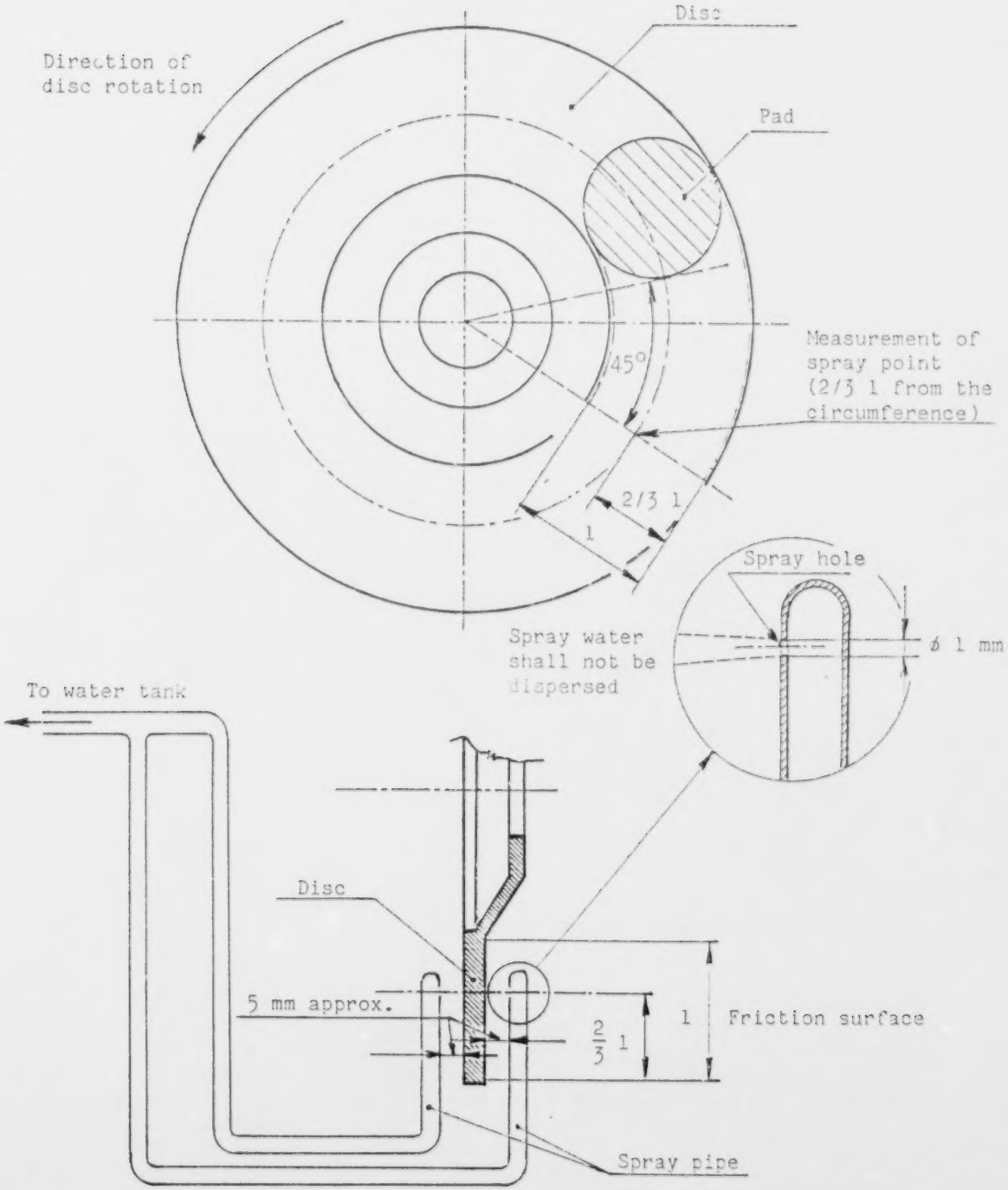
*/ Vehicles of which the maximum speed (Vmax) is lower than 45 km/h in the case of categories L_1 and L_2 or 67 km/h in the case of categories L_3, L_4 and L_5, shall be tested at a speed equal to 0.9 Vmax.

Add a new appendix to annex 3 to read as follows:

Annex 3 - Appendix

METHOD OF WATER APPLICATION



2.3. Braking performance with the parking braking device (if applicable).

The parking braking device must, even if it is combined with one of the other braking devices, be capable of holding the laden vehicle stationary on an 18% up or down gradient.

2.4. Forces applied to service brake controls:
hand control $\leq$ 200 N
foot control $\leq$ 350 N (L_1, L_2, L_3, L_4)
$\leq$ 500 N (L_5)

parking brake control (if applicable):
with manual control $\leq$ 400 N
with foot control $\leq$ 500 N

In the case of hand brake levers, the point of application of the manual force shall be assumed to be 50 mm from the outer end of the lever.

2.5. Performance levels (minimum and maximum) to be attained with wet brakes.

2.5.1. The mean deceleration to be attained with wet brake(s) between 0.5 and 1.0 second after application of the brake shall be at least 60% of that attained with dry brake(s) when the same control force is applied.

2.5.2. The control force used, which must be applied as quickly as possible, shall be equivalent to that required to attain a deceleration of 2.5 m/s^2 with dry brake(s).

2.5.3. At no time during the type-0 test with wet brake(s) shall the deceleration exceed 120 % of that attained with dry brake(s)."

Add a new Annex 4 and an Appendix to Annex 4:

"Annex 4

REQUIREMENTS APPLICABLE TO VEHICLES OF CATEGORIES L_1 and L_3 EQUIPPED WITH ANTI-LOCK DEVICES

1. GENERAL

1.1. The purpose of these provisions is to define minimum performances for braking systems with anti-lock devices fitted to vehicles of categories L_1 and L_3. This does not make it compulsory to fit vehicles with anti-lock devices but if such devices are fitted to a vehicle they must meet the requirements below.

1.2. The devices known at present comprise a sensor or sensors, a controller or controllers and a modulator or modulators. Any devices of a different design will be deemed to be anti-lock devices within the meaning of this annex if they provide performances at least equal to those prescribed by this annex.

2. DEFINITIONS

2.1. An '<u>anti-lock device</u>' is a component of a service braking system which automatically controls the degree of slip, in the direction of rotation of the wheel(s) on one or more wheels of the vehicle during braking;

2.2. '<u>Sensor</u>' means a component designed to identify and transmit to the controller the conditions of rotation of the wheel(s) or the dynamic conditions of the vehicle;

2.3. '<u>Controller</u>' means a component designed to evaluate the data transmitted by the sensor(s) and to transmit a signal to the modulator;

2.4 '<u>Modulator</u>' means a component designed to vary the braking force(s) in accordance with the signal received from the controller.

3. NATURE AND CHARACTERISTICS OF THE SYSTEM

3.1. Each controlled wheel shall be such that it can bring at least its own device into operation.

3.2. Any break in the supply of electricity to the device and/or in the wiring external to the electronic controller(s) shall be signalled to the driver by an optical warning signal, which must be visible even in daylight; it must be easy for the driver to check that it is in working order. <u>1</u>/

3.3. In the event of a failure in an anti-lock device, the braking efficiency of the laden vehicle shall not be less than that prescribed for whichever is the lower of the two requirements for the vehicle defined in paragraph 2.1.2.1. or paragraph 2.1.2.2. of annex 3 of this Regulation.

3.4. The operation of the device must not be affected adversely by electro-magnetic fields. <u>2</u>/

3.5. Anti-lock devices must maintain their performance when the brake is fully applied for the duration of any stop.

<u>1</u>/ The Technical Service should examine the electronic controller and/or any drive system with regard to possible failure modes.

<u>2</u>/ Until uniform test procedures have been agreed, the manufacturers shall provide the Technical Service with their test procedures and results.

4. UTILIZATION OF ADHESION

4.1. General

4.1.1. In the case of vehicles of category L_3, braking systems equipped with an anti-lock device shall be deemed acceptable when the condition $\varepsilon \geq 0.70$ is satisfied where ε represents the adhesion utilized as defined in the appendix to this annex. 3/

4.1.2. The coefficient of adhesion utilization ε shall be measured on road surfaces with a coefficient of adhesion not exceeding 0.45 and of not less than 0.8.

4.1.3. Tests shall be carried out with the vehicle unladen.

4.1.4. The test procedure to determine the coefficient of adhesion (K) and the formula for calculating the adhesion utilization (ε) shall be those prescribed in the appendix to this annex.

5. ADDITIONAL CHECKS

The following additional checks shall be carried out with the vehicle unladen.

5.1. Any wheel controlled by an anti-lock device must not lock when the full force 4/ is suddenly applied to its control device, on the two kinds of road surface specified in paragraph 4.1.2. above at initial speeds of up to 0.8 Vmax but not exceeding 80 km/h. 5/

5.2. When a wheel controlled by an anti-lock device passes from a high-adhesion surface to a low-adhesion surface as described in paragraph 4.1.2. above with the full force 4/ applied to the control device, the wheel must not lock. The running speed and the instant of applying the brakes shall be so calculated that, with the anti-lock device fully cycling on the high-adhesion surface, the passage from one surface to the other is made at about 0.5 Vmax not exceeding 50 km/h.

3/ For L_1 vehicles, until a minimum value for ε has been established, the measured value shall be recorded in the test report.

4/ 'Full force' means the maximum force prescribed in paragraph 2.4. of annex 3 for the category of vehicle: a higher force may be used if required to activate the anti-lock device.

5/ On low adhesion surfaces (≤ 0.35) the initial spe d may be reduced for safety reasons: in such cases, the K value and the initial speed shall be noted in the test report.

5.3. When a vehicle passes from a low-adhesion surface to a high-adhesion surface as described in paragraph 4.1.2. above with the full force 4/ applied to the control device, the deceleration of the vehicle must rise to the appropriate high value within a reasonable time and the vehicle must not deviate from its initial course. The running speed and the instant of applying the brakes shall be so calculated that, with the anti-lock device fully cycling on the low-adhesion surface, the passage from one surface to the other occurs at about 0.5 Vmax not exceeding 50 km/h.

5.4. Where both independent braking devices are equipped with an anti-lock device the tests prescribed in paragraphs 5.1., 5.2. and 5.3. shall also be performed using both independent braking devices together whereupon the stability of the vehicle shall be maintained at all times.

5.5. However, in the tests provided for in paragraphs 5.1., 5.2., 5.3., and 5.4. above periods of wheel locking or of extreme wheel slip shall be allowed provided that the stability of the vehicle is not adversely affected. Below vehicle speeds of 10 km/h wheel locking is permitted.

Annex 4

Appendix

1. DETERMINATION OF THE COEFFICIENT OF ADHESION (K)

1.1. The coefficient of adhesion shall be determined from the maximum braking rate, without wheel lock, of the vehicle with the anti-lock device(s) disconnected and braking both wheels simultaneously. 1/

1.2. Braking tests should be carried out by applying the brakes at an initial speed of about 60 km/h (or, in the case of vehicles unable to attain 60 km/h, at a speed of about 0.9 Vmax) with the vehicle unladen (except for any necessary test instrumentation and/or safety equipment). Constant brake control forces must be used throughout the tests.

1.3. A series of tests may be carried out up to the critical point reached immediately before the wheel(s) lock by varying both the front and the rear brake forces, in order to determine the maximum braking rate of the vehicle. 2/

1.4. The braking rate (Z) will be determined by reference to the time taken for the speed of the vehicle to reduce from 40 km/h to 20 km/h, using the formula:

$$Z = \frac{0.56}{t}$$

where t is measured in seconds.

Alternatively, for vehicles unable to attain 50 km/h, the braking rate shall be determined by reference to the time taken for the speed of the vehicle to reduce from 0.8 Vmax to (0.8 Vmax - 20) where Vmax is measured in km/h.

The maximum value of Z = K.

1/ Additional requirements may have to be established in the case of vehicles equipped with combined braking systems.

2/ As an initial step, to facilitate these preliminary tests, the maximum control force applied before the critical point may be obtained for each individual wheel.

2. DETERMINATION OF THE ADHESION UTILIZATION (ε)

2.1. The adhesion utilized is defined as the quotient of the maximum braking rate with the anti-lock device in operation (Zmax) and the maximum braking rate with the anti-lock device disconnected (Zm). Separate tests must be carried out on each wheel equipped with an anti-lock device.

2.2. Zmax shall be based on the average of three tests using the time taken for the speed of the vehicle to achieve the reductions in speed specified in paragraph 1.4. above.

2.3. The adhesion utilized is given by the formula:

$$\varepsilon = \frac{Zmax}{Zm}$$ "